

Mandatory Experiments **(Light)**

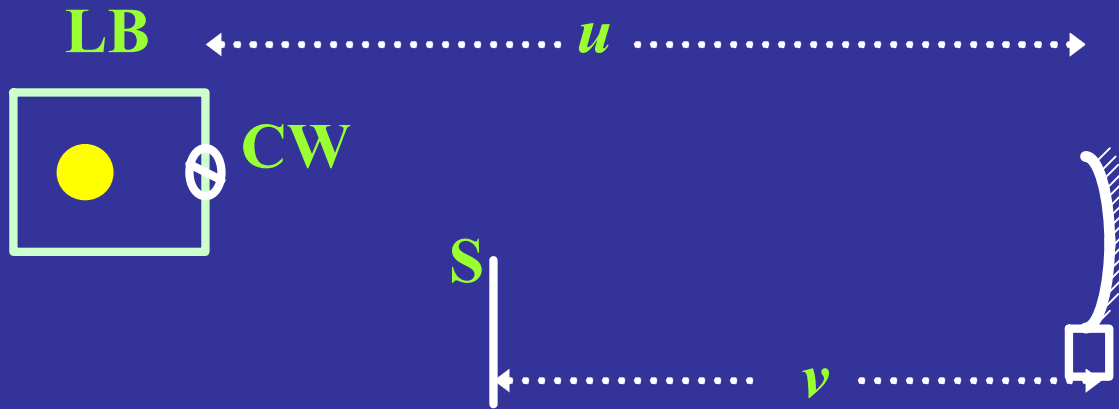
- Light 1** **Measure Focal Length of a Concave Mirror**
- Light 2** **Verify Snell's Law of Refraction**
- Light 3** **Measure Refractive Index**
- Light 4** **Measure Focal Length of a Converging Lens**
- Light 5** **Measure Wavelength of Monochromatic Light**

Light 1

Focal Length of a Concave Mirror

Expt. Focal Length Of A Concave Mirror

Apparatus



Lamp box with cross-wires

Concave mirror

Screen

Metre stick

Concave Mirror

Procedure

- Get approx. first (Method = ??)

Set $u > f$

Move screen back & forth to get a sharp image of ...

- Measure (2) ...

- How are these measured?

- Repeat...other...

Why repeat?

Concave Mirror

Procedure

- Get approx. first (Method = ??)

Set $u > f$

Move screen back & forth to get a sharp image of ...

- Measure (2) ... u and v

- u = distance from mirror to cross-hairs

v = distance from mirror to screen

- Repeat for other u & v , to get average f .

Concave Mirror

Results

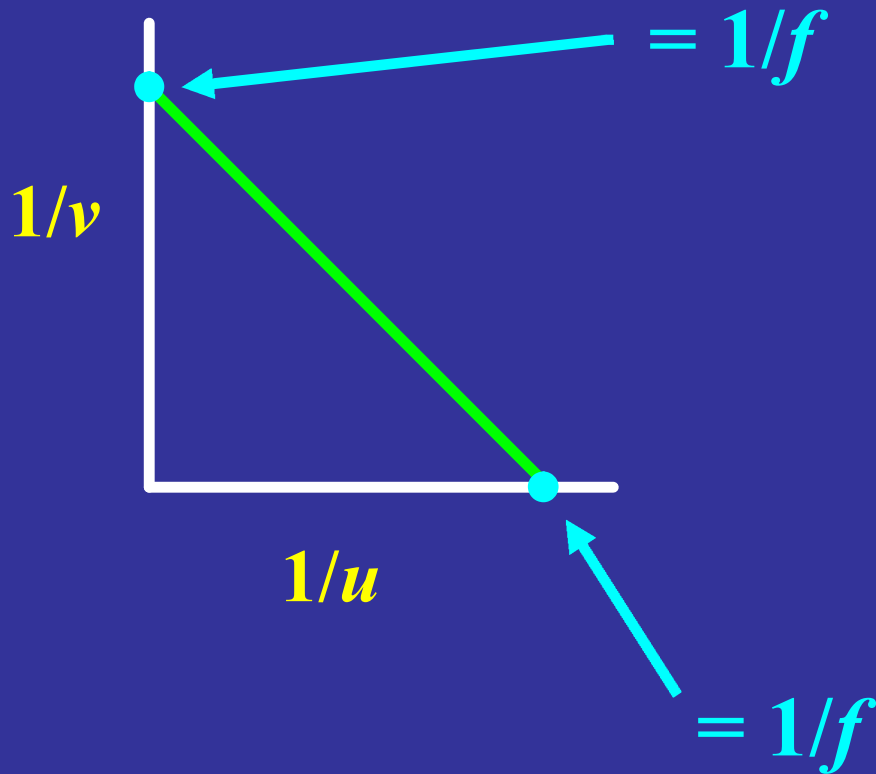
$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

Repeat for several u and v values
and calculate the average f .

Concave Mirror

Results

(Alternative Method)



$$1/u + 1/v = 1/f$$

$$0 + 1/v = 1/f$$

$$1/v = 1/f$$

Get average f

$$1/u + 1/v = 1/f$$

$$1/u + 0 = 1/f$$

$$1/u = 1/f$$

Concave Mirror

Precautions / Questions

1. Give two precautions taken to ensure an accurate result.
2. Why is the experiment repeated several times?
3. What error should be avoided when using the metre stick?
4. Why is the value of u obtained more accurate than the value of v ?
5. Give two errors that can arise when measuring v .
6. How would you improve the accuracy of the v measurement?
7. If you could not find any sharp image of the cross-threads what is likely to be the problem?
8. From what point on the mirror are measurements taken?
9. How is the approximate focal length found?

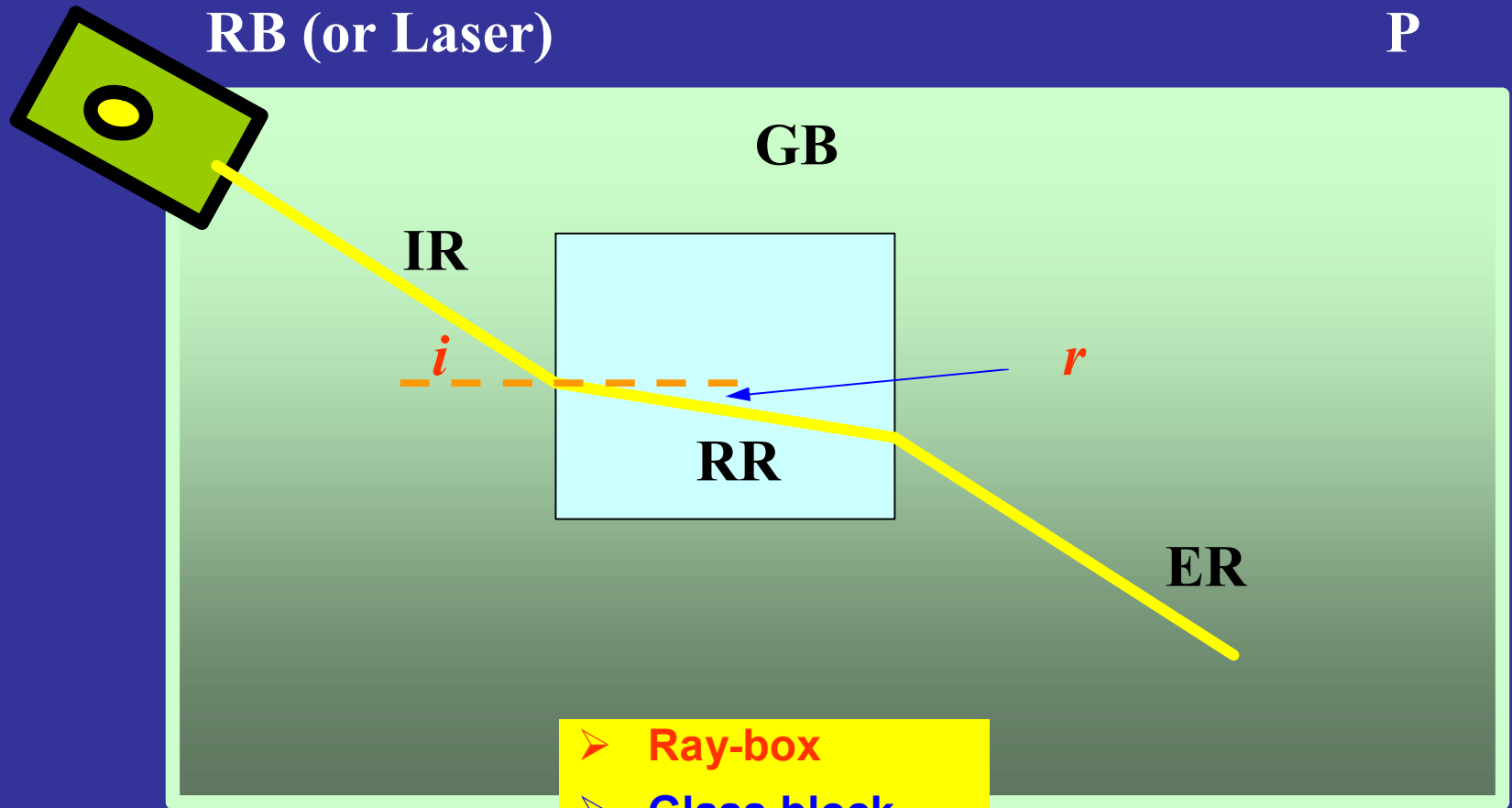
Light 2

Verify Snell's Law of Refraction

Verify Snell's Law of Refraction

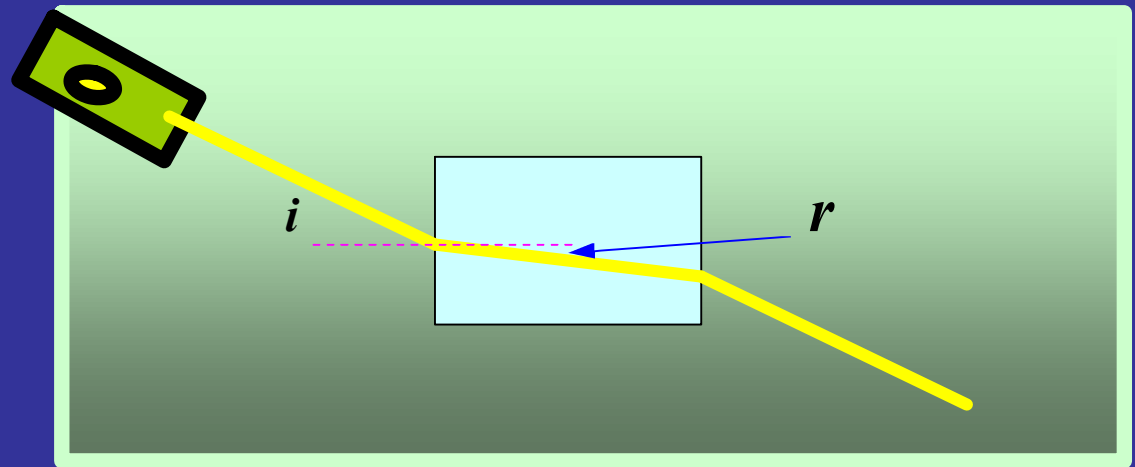
(or Verify the Laws of Refraction)

Apparatus



- Ray-box
- Glass block
- Paper
- Protractor

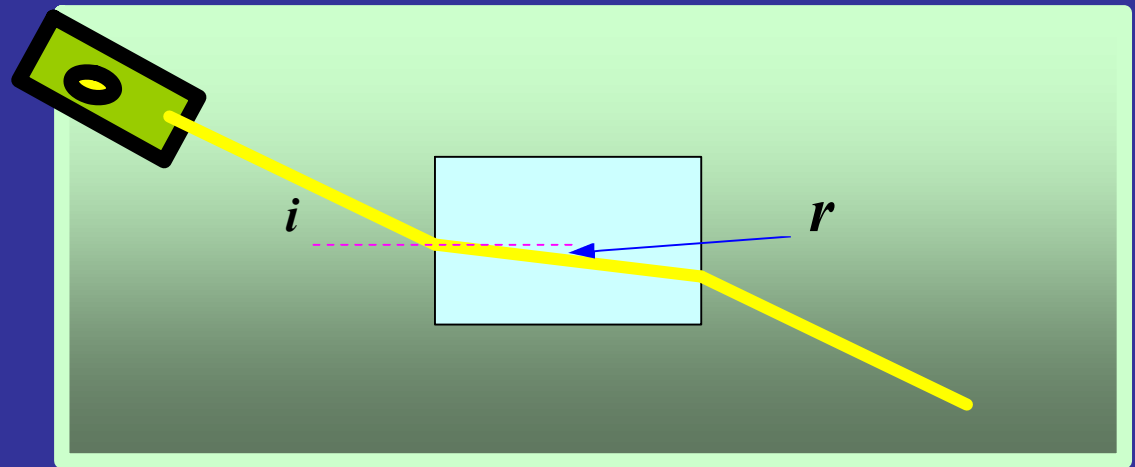
Snell's Law



Procedure

- Outline the block ... 2 dots on each ray ... Join dots
Join point of incidence to point of emergence
Complete the diagram ...
- Measure (2) ...
- How are these measured?
- Repeat / other ... / why?

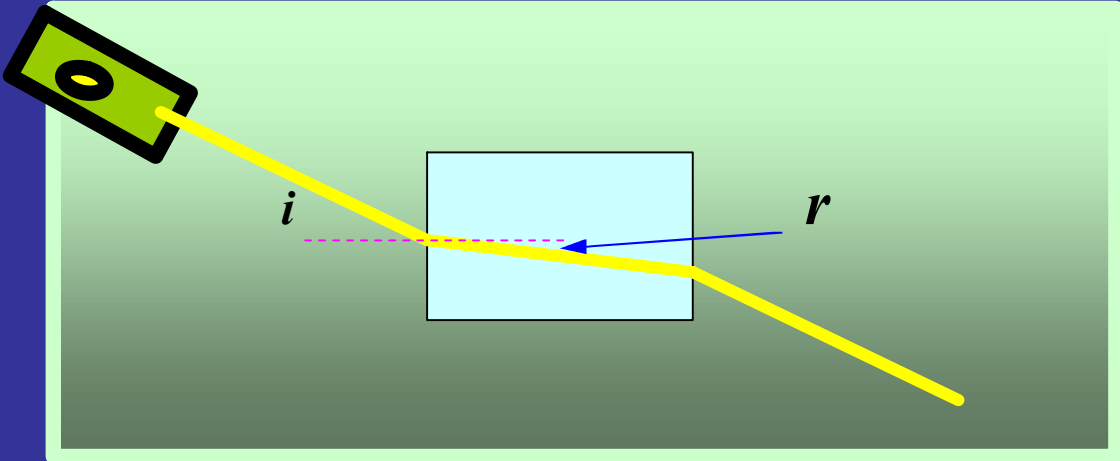
Snell's Law



Procedure

- Outline the block ... 2 dots on each ray ... Join dots
Join point of incidence to point of emergence
Complete the diagram ...
- Measure (2)
... angles i and r (shown in diagram) ... use a protractor
- Repeat for other i and r ... / why?

Snell's Law

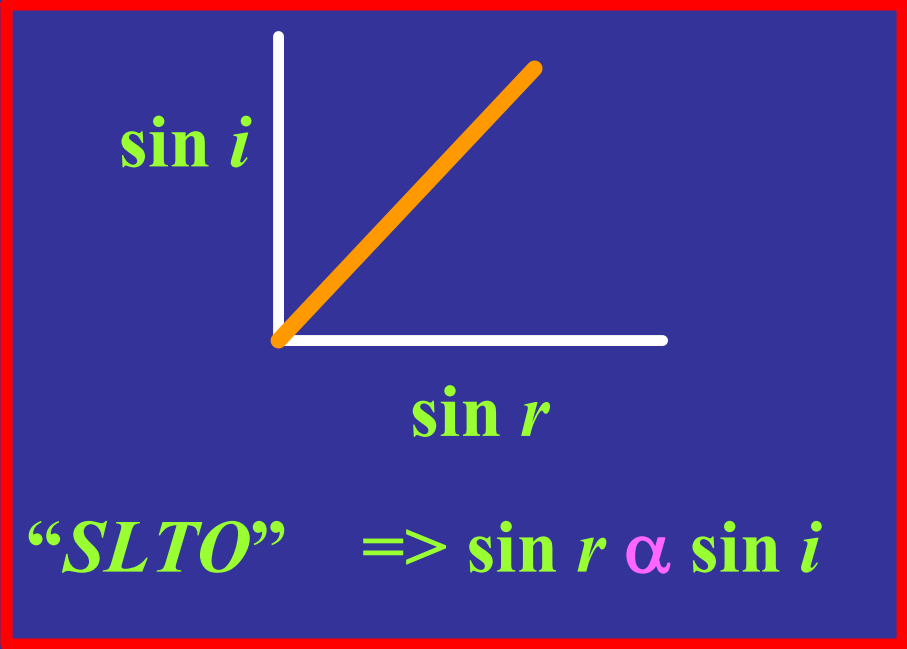


Result

$$\sin i \div \sin r = \text{a constant}$$

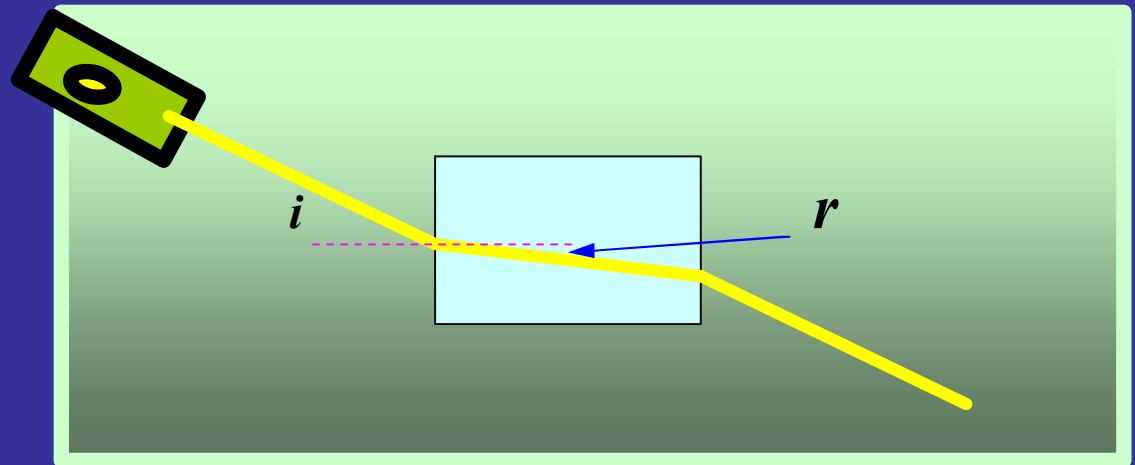
$$\Rightarrow \sin i \propto \sin r$$

or



$$\text{"SLTO"} \Rightarrow \sin r \propto \sin i$$

Snell's Law



Precautions / Questions

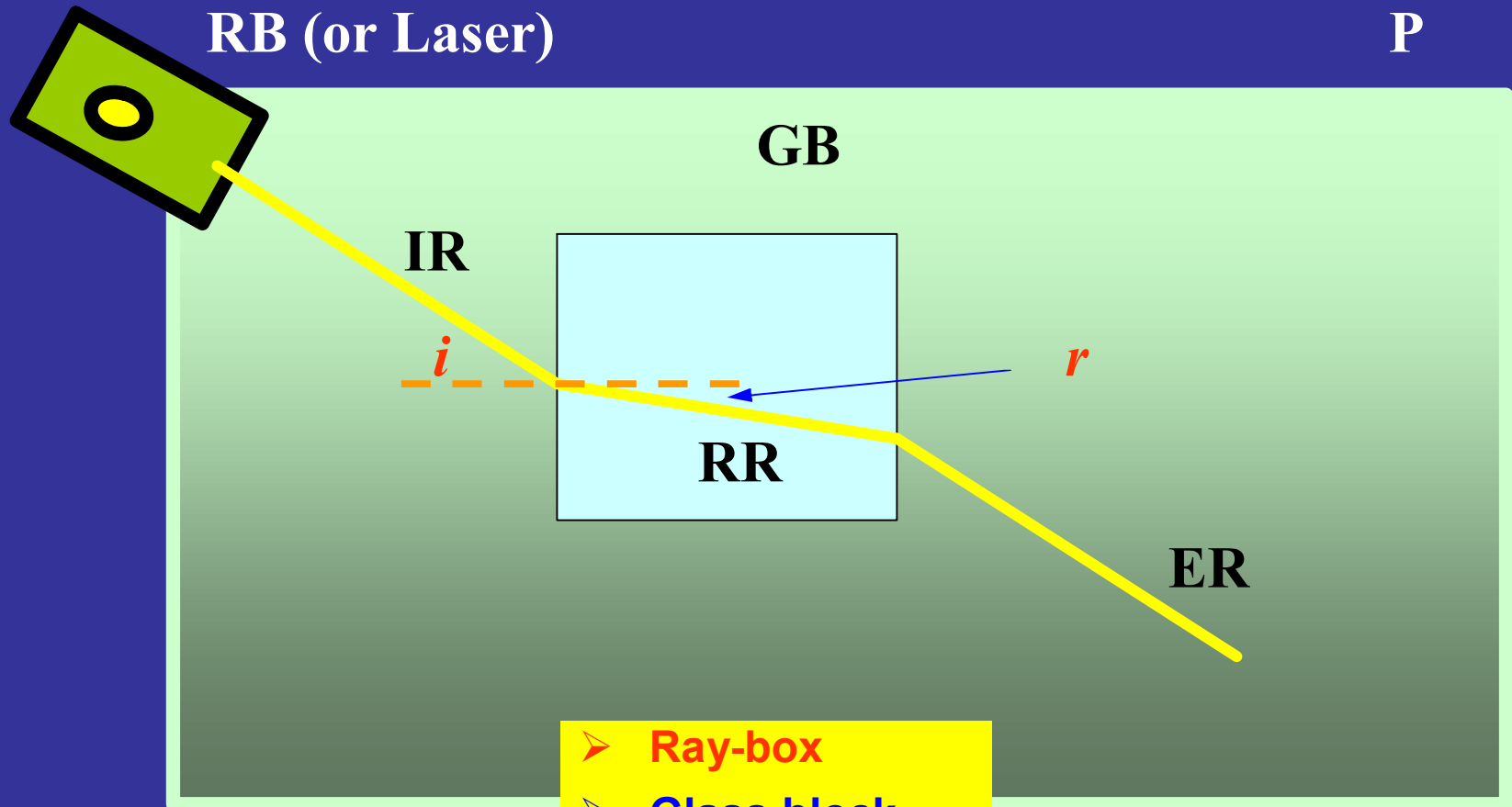
- 1.. Give two precautions taken to ensure an accurate result.
2. Why is it better to use reasonably large angles?
3. Why should the glass block be outlined?
4. Why use a thin ray? (This is done by turning the bulb in the ray-box.)
5. Why send the light through a larger thickness of glass?
6. Why is the experiment repeated several times?
7. Avoid parallax errors when using (2)
8. What does the slope of the graph that is drawn represent?
9. Label the refracted ray.

Light 3 (Method 1)

**Measure Refractive Index of a
Liquid or Solid**

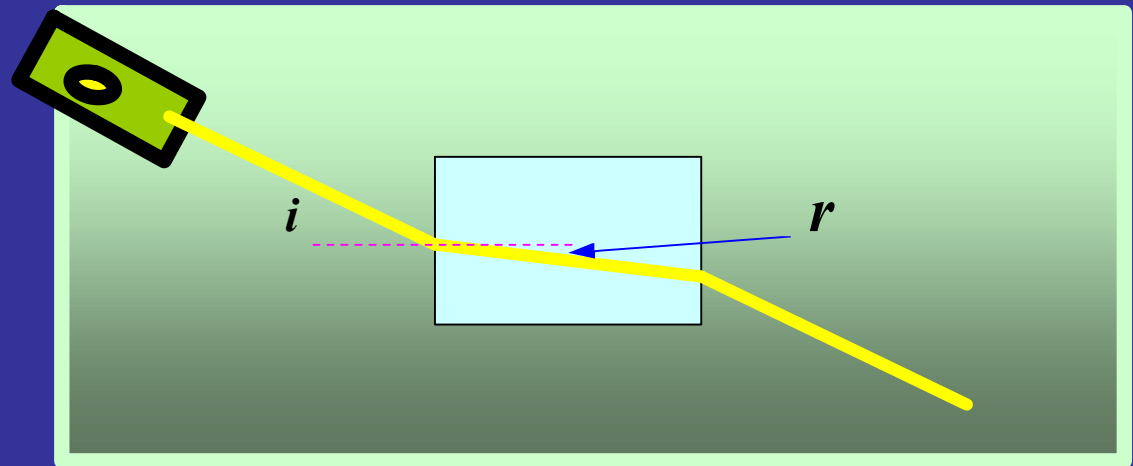
To Measure Refractive Index

Apparatus



- Ray-box
- Glass block
- Paper
- Protractor

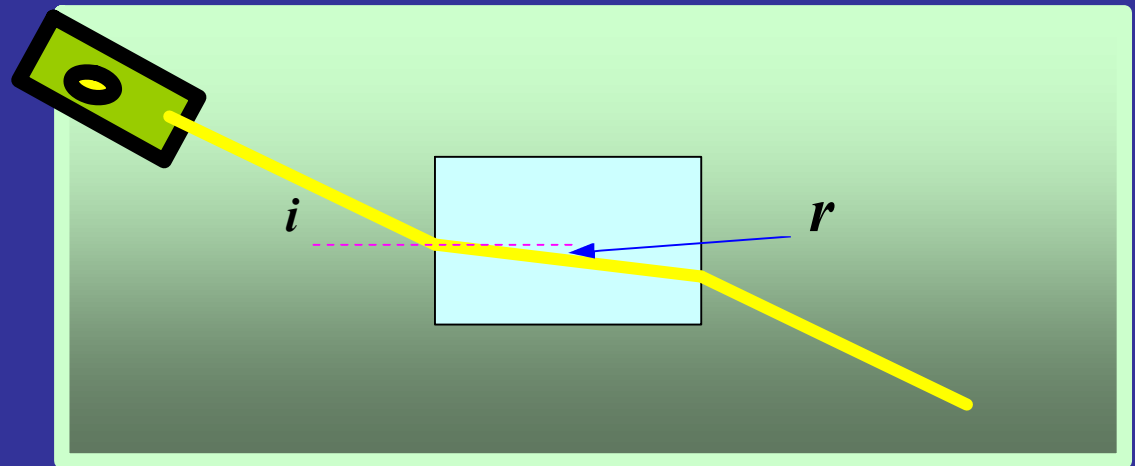
Refractive Index (1)



Procedure

- **Outline the block ... 2 dots on each ray ... Join dots**
Join point of incidence to point of emergence
Complete the diagram ...
- **Measure (2) ...**
- **How are these measured?**
- **Repeat... other... Why repeat?**

Refractive Index (1)



Procedure

- Outline the block ... 2 dots on each ray ... Join dots
Join point of incidence to point of emergence
Complete the diagram ...
- Measure (2)
... angles i and r (shown in diagram) ... use a protractor
- Repeat for other i and r ... to graph.

Refractive Index (1)

Results

$$n = \sin i \div \sin r$$

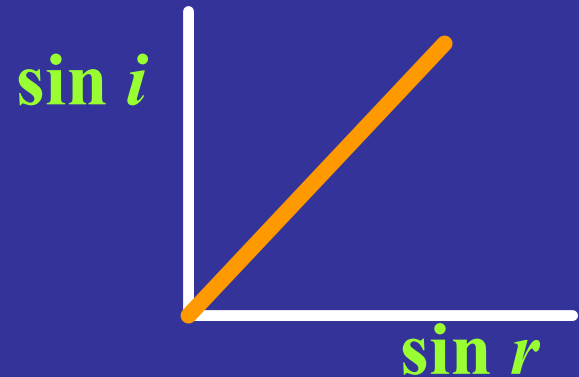
Calculate average n

or

$$n = \sin i \div \sin r$$

$$\sin i = n \sin r$$

$$y = m x$$



Liquid ... use a hollow block

Refractive Index (1)

Precautions / Questions

1. Give two precautions taken to ensure an accurate result.
2. Why is it better to use reasonably large angles?
3. Why should the glass block be outlined?
4. Why use a thin ray? (This is done by turning the bulb in the ray-box.)
5. Why send the light through a larger thickness of glass?
6. Why is the experiment repeated several times?
7. Avoid parallax errors when using (2)
8. What does the slope of the graph that is drawn represent?
9. Label the refracted ray.
10. Etc.

Light 3 (Method 2)

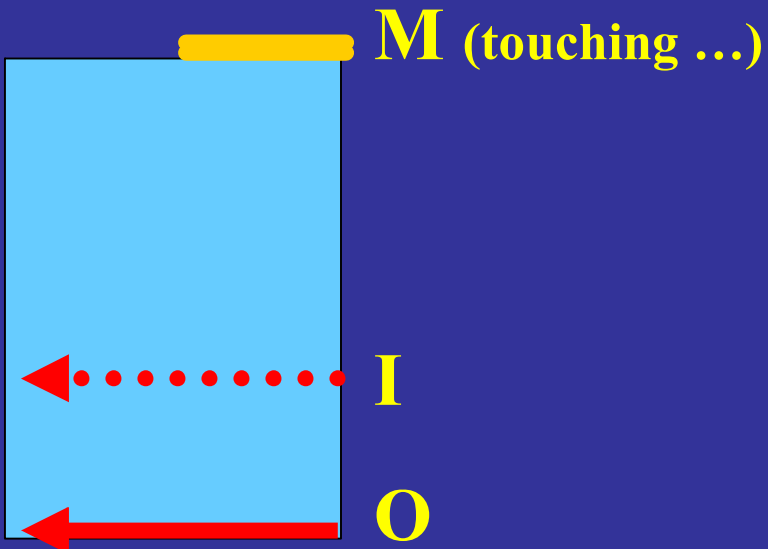
**Measure Refractive Index of a
Liquid or a Solid**

Expt. Refractive Index Of A Liquid



Apparatus

- Jar
- Liquid
- Pins x2
- Plane mirror
- Metre stick

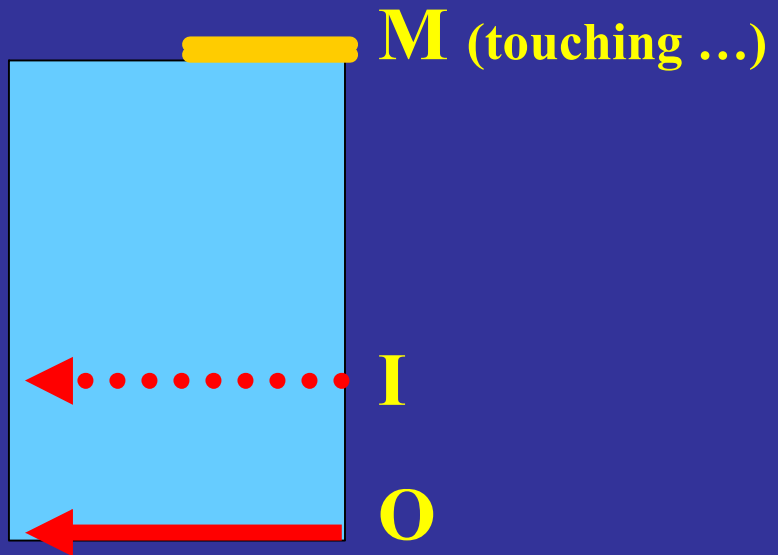


Refractive Index (2)

Procedure



- **Move S to get no parallax between and ...**
- **Measure (2) ...**
- **How are these measured?**
- **Repeat for other ... Why repeat?**



Refractive Index (2)

Procedure

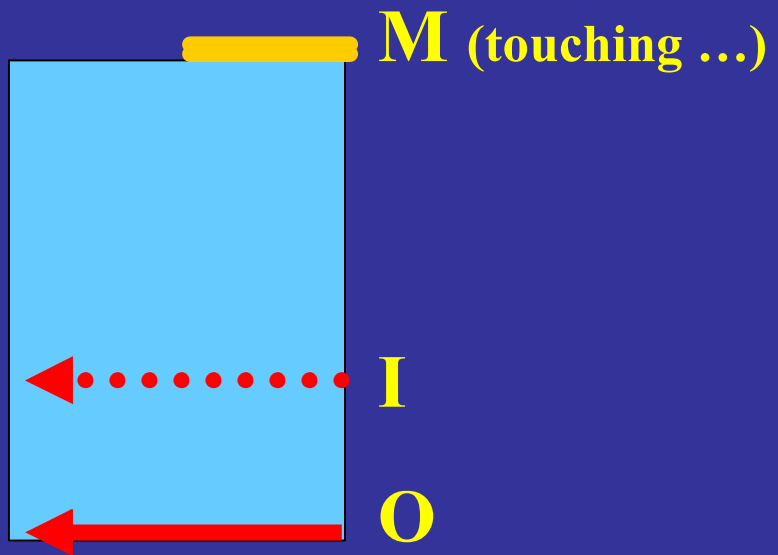
- Move S to get no parallax between and ...
- Measure (2)
... real depth and apparent depth
- Real depth = MO Apparent depth = MS
- Repeat for other depths and calculate average n .

Refractive Index (2)



Results

$$n = \text{real depth} \div \text{apparent depth}$$
$$n = MO \div MS$$



Precautions / Questions

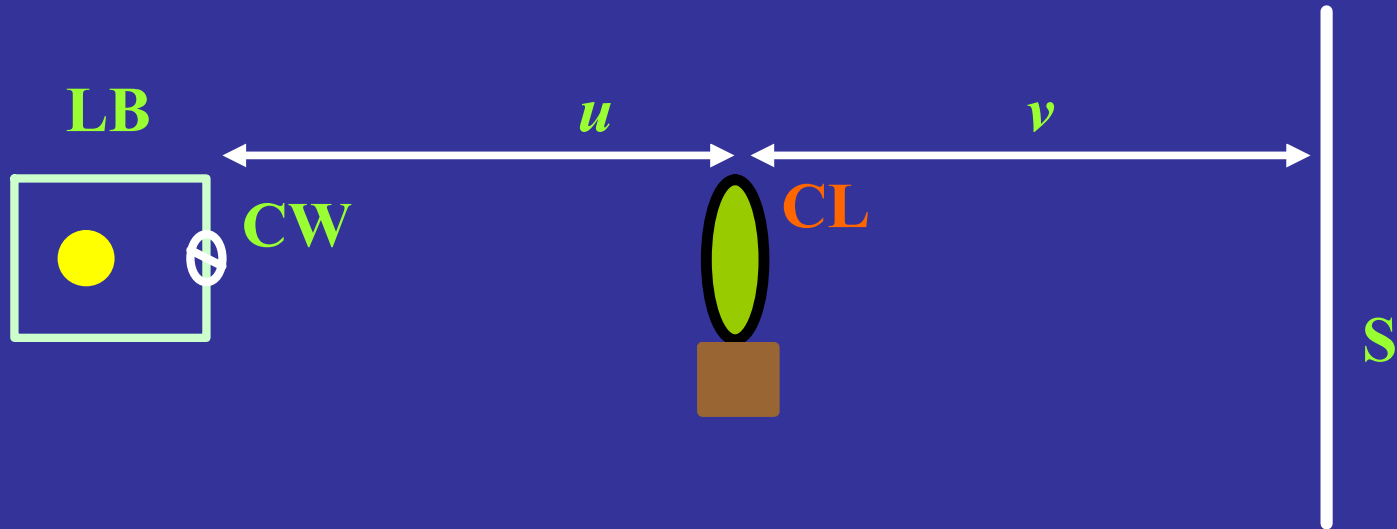
1. Give two precautions taken to ensure an accurate result.
2. Give two sources of error involved in getting the apparent depth.
3. Why is the experiment repeated?
4. Avoid parallax error when using the metre stick.
5. Why is it better to use a larger depth of liquid?
6. From what part of the mirror, front or back, is the apparent depth measured?
7. Why should the water be touching the back of the mirror?

Light 4

**Measure Focal Length of a
Converging Lens**

Focal Length of a Converging Lens

Apparatus



Lamp box with cross-wires

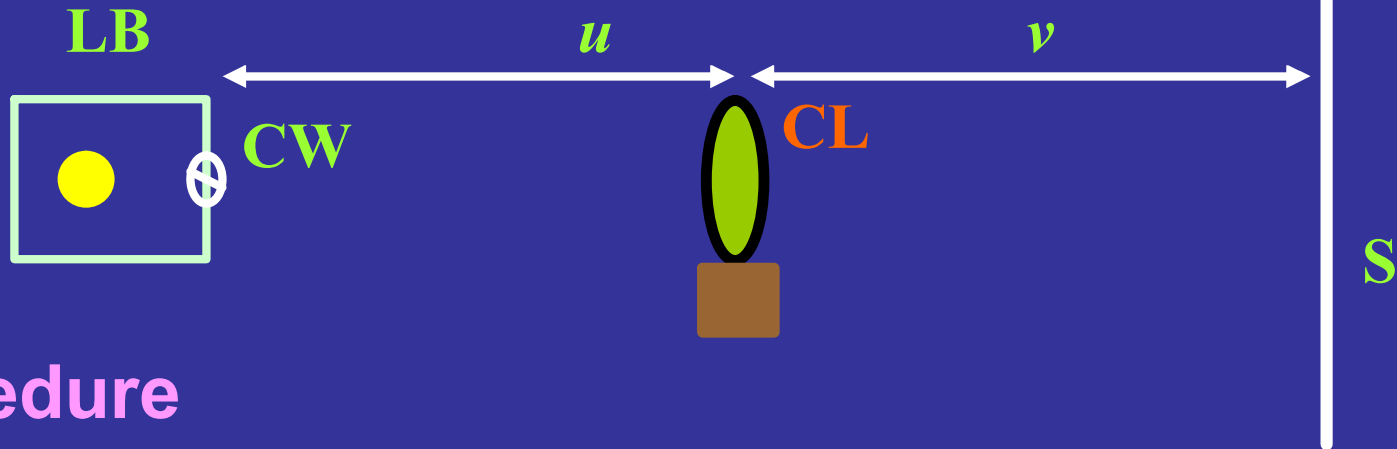
Convex lens

Screen

Metre stick

Converging Lens

Apparatus



Procedure

- Get approx. f first (Method = ??)
Set $u > f$
Move screen back & forth to get a sharp image of ...
- Measure (2) ...
- How are these measured?
- Repeat... other... Why repeat?

Converging Lens

Procedure

- Get approx. first (Method = ??)
- Set $u > f$
- Move screen back & forth to get a sharp image of ...
- Measure (2) ... u and v
- u = distance from lens to cross-hairs
 v = distance from lens to screen
- Repeat for other u & v and calculate average f .

Converging Lens

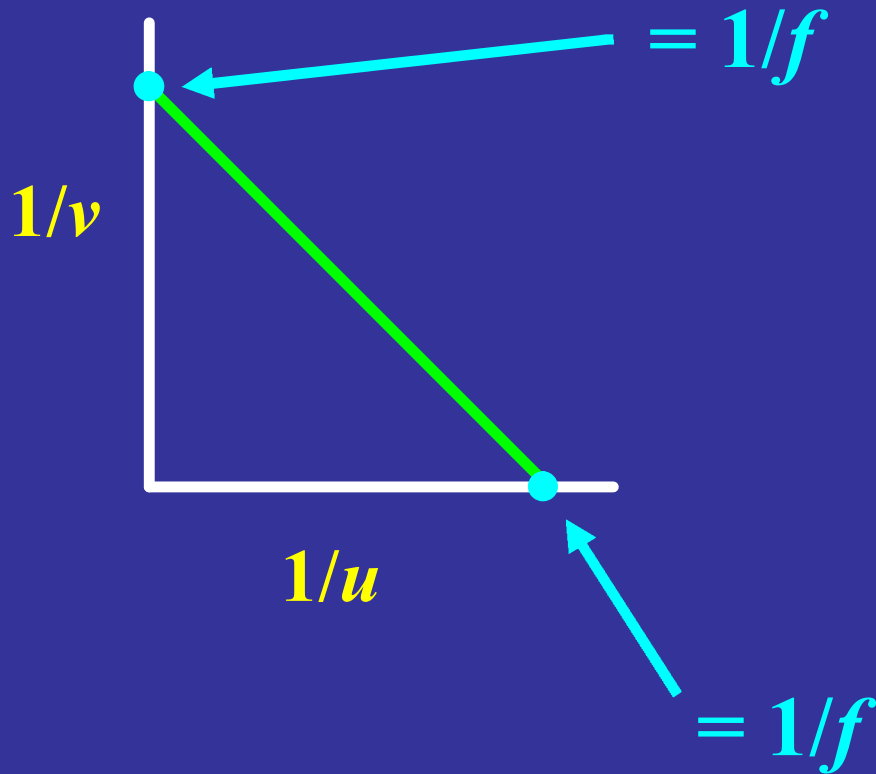
Results

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

Calculate average f

Converging Lens

Result - Alternative Method



$$\begin{aligned}1/u + 1/v &= 1/f \\0 + 1/v &= 1/f \\1/v &= 1/f\end{aligned}$$

Get average f

$$\begin{aligned}1/u + 1/v &= 1/f \\1/u + 0 &= 1/f \\1/u &= 1/f\end{aligned}$$

Converging Lens

Precautions / Questions

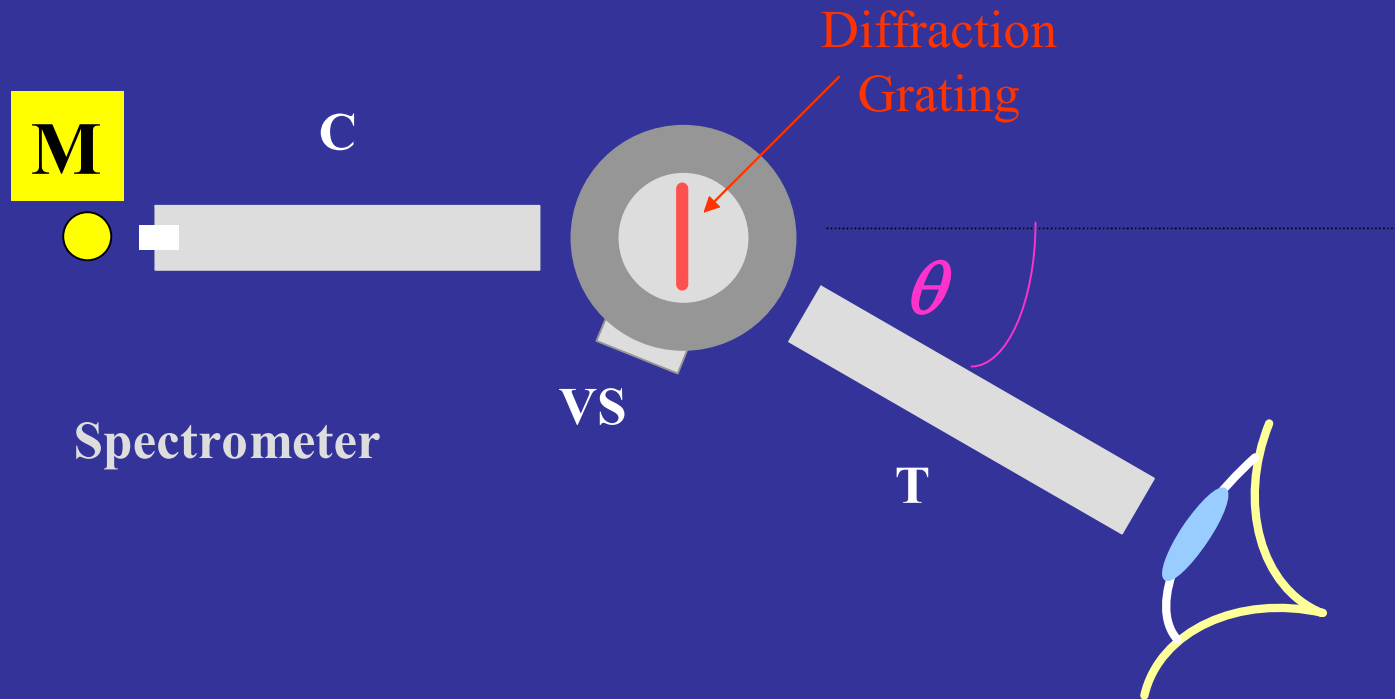
1. Give two precautions taken to ensure an accurate result.
2. Why is the experiment repeated several times?
3. What error should be avoided when using the metre stick?
4. Why is the value of u obtained more accurate than the value of v ?
5. Give two errors that can arise when measuring v .
6. How would you improve the accuracy of the v measurement?
7. If you could not find any sharp image of the cross-threads what is likely to be the problem?
8. From what point on the mirror are measurements taken?
9. How is the approximate focal length found?

Light 5 (Method 1)

**Measure Wavelength of
Monochromatic Light
(Spectrometer Method)**

Wavelength (Spectrometer)

Apparatus

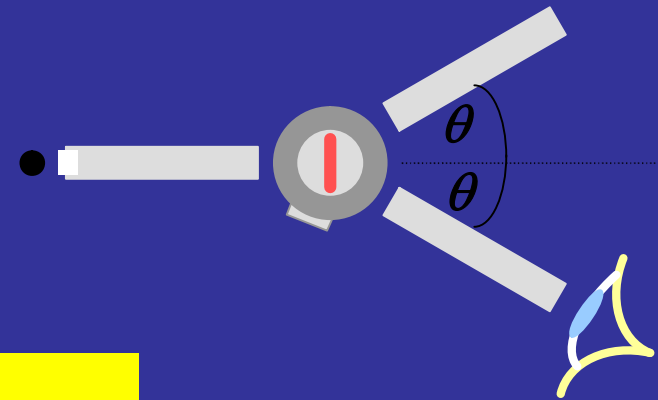


Spectrometer (Telescope, Collimator, Table, Main + Vernier Scales)

Diffraction grating

Monochromatic light source

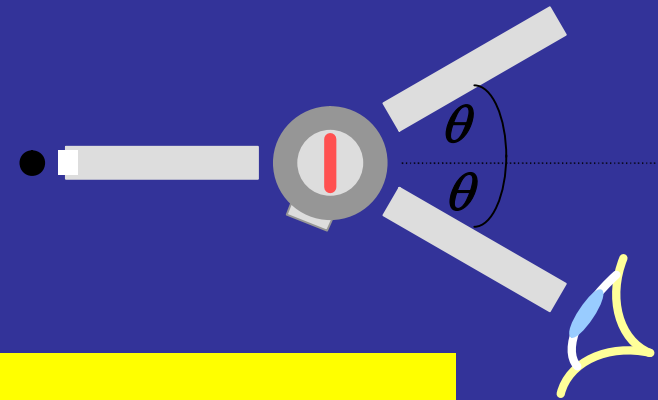
Wavelength (Spectrometer)



Procedure

- Look at different order images and take angle readings.
- Measure **(3)** ...
- **How are these measured?**
- Repeat .. other ... Why repeat?

Wavelength (Spectrometer)



Procedure

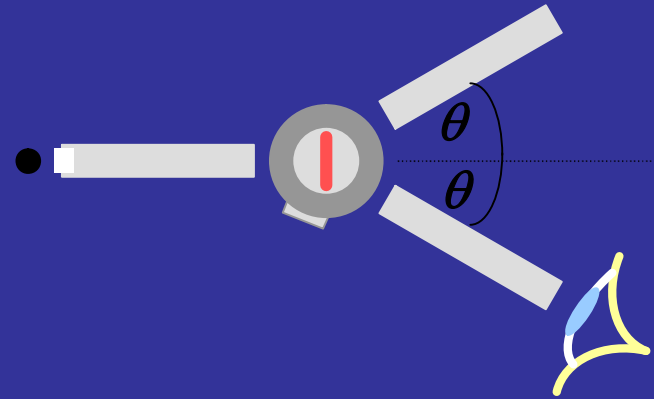
- Look at different order images and take angle readings.
- Measure (3) ... θ , n , d
- $\theta = \frac{1}{2} (\theta_R - \theta_L)$
 $n = 1, 2, 3$, etc (order of image),
 $d = 1 \div$ no. of lines per metre
- Repeat .. other orders ... to get average λ .

Wavelength (Spectrometer)

Results

$$n\lambda = d \sin \theta$$

Calculate average λ



Wavelength (Spectrometer)

Precautions / Questions

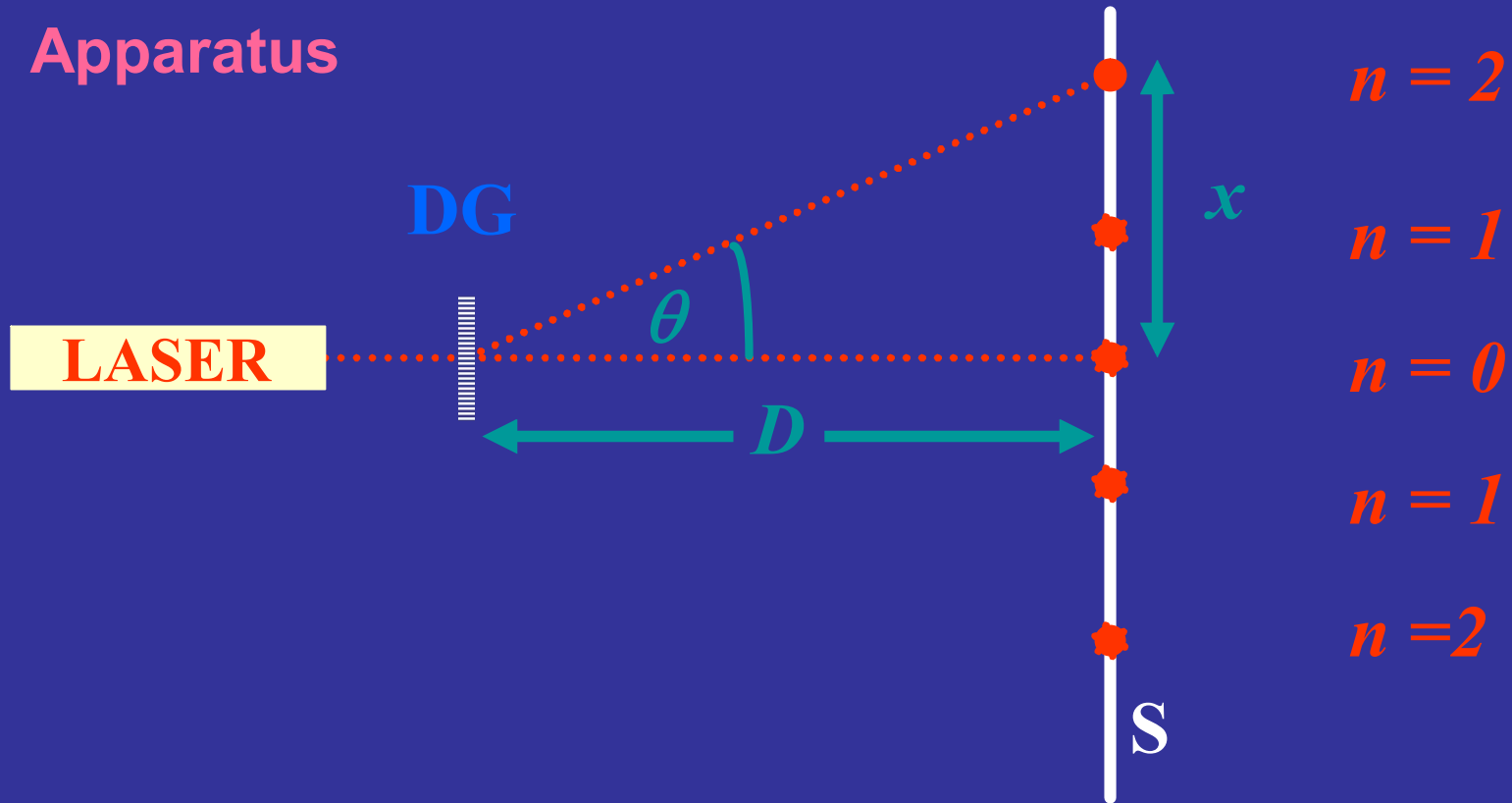
1. Give three precautions taken to ensure an accurate result.
2. Why is the experiment repeated several times?
3. The values for the angles on the left of the central image are smaller than the corresponding images on the right. Suggest two possible reason for this.
4. Give five adjustments that should be made to the spectrometer.
5. The diffraction grating should be placed perpendicular to and perpendicular to
6. What are the functions of, (i) the collimator, (ii) the telescope?
7. Why should the slit be narrow?
8. On what part of the image is the cross-hairs placed?
9. Why is it better to use a 600 lines per mm grating than to use a 300 lines per mm grating?
10. What is the advantage of having a Vernier scale?
11. If the image seen on one side of the central image are above the centre of the eyepiece and the images on the other side are below the centre, what adjustment should be made to the spectrometer?

Light 5 (Method 2)

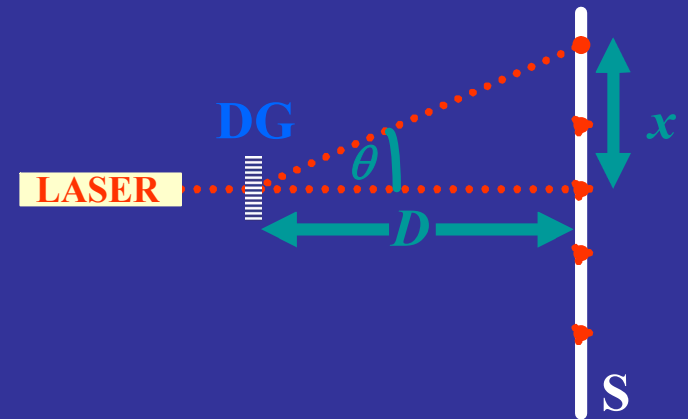
**Measure Wavelength of
Monochromatic Light
(Laser Light)**

Expt. Wavelength of Laser Light

Apparatus



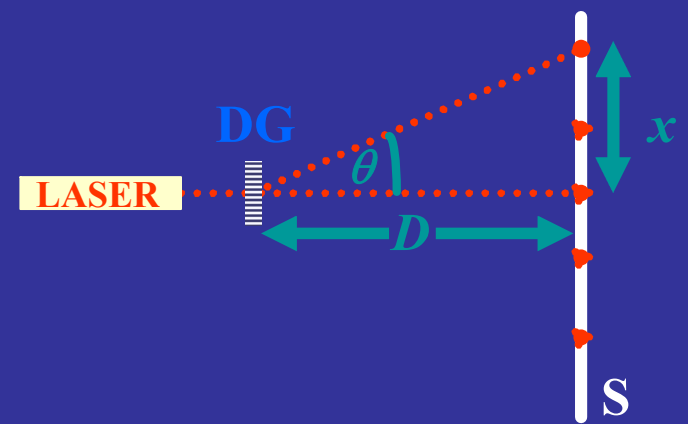
Wavelength (Laser)



Procedure

- Bright images on the screen ... take readings
- Measure (3) ...
- How are these readings taken?
- Repeat... other... ... Why repeat?

Wavelength (Laser)



Procedure

- Bright images on the screen ... take readings
- Measure (3) ... θ , n , d



$$\tan\theta = \frac{x}{D}$$

$n = 1, 2, 3$ etc. (order of image)

$d = 1 \div$ no. of lines per metre

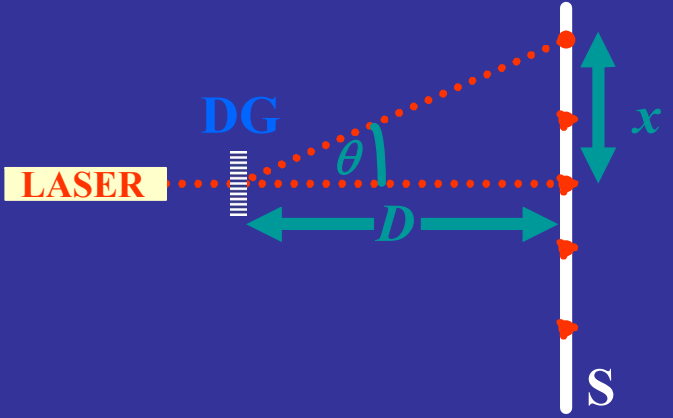
- Repeat .. other orders ... to get average λ .

Wavelength (Laser)

Results

$$n\lambda = d \sin \theta$$

where $\tan \theta = \frac{x}{D}$



Wavelength (Laser)

Precautions / Questions

1. Give three precautions taken to ensure an accurate result.
2. Why is the experiment repeated several times?
3. The values for the angles on the left of the central image are smaller than the corresponding images on the right. Suggest two possible reason for this.
4. The diffraction grating should be placed perpendicular to and perpendicular to
5. Why is it better to use a 600 lines per mm grating than to use a 300 lines per mm grating?
6. What error should be avoided when using the metre stick?
7. Why is it better to have larger values for x and for D ?